

**CLAIMS:**

- 1 1. A detector assembly for improved depth of interaction determinations comprising:
  - 2 a scintillator crystal for interacting with a photon and creating a plurality of
  - 3 optical signals, said scintillator crystal having a first end and a second end;
  - 4 a first transducer for receiving one the plurality optical signals from said
  - 5 scintillator crystal and converting the one the plurality optical signals to a first electrical
  - 6 signal, said first transducer having a first active area for receiving optical signals, and
  - 7 said first active area of said first transducer being optically coupled to the first end of said
  - 8 scintillator crystal;
  - 9 a second transducer for receiving another of the plurality optical signals from said
  - 10 scintillator crystal and converting the one the plurality optical signals to a second
  - 11 electrical signal, said second transducer having a second active area for receiving optical
  - 12 signals and said second active area of said second transducer being optically aligned for
  - 13 receiving optical signals from second end of said scintillator crystal; and
  - 14 an optical guide, said optical guide optically coupled between said second end of
  - 15 said scintillator crystal and said active area of said second transducer, said optical guide
  - 16 being conducive to direct optical signals to said active area of said second transducer.
- 1 2. The detector assembly recited in claim 1 above, wherein said first active area is
- 2 larger than said second active area.
- 1 3. The detector assembly recited in claim 1 above, wherein said scintillator crystal
- 2 further comprising:
  - 3 a plurality of slits, each of said plurality of slits being approximately equal in
  - 4 length.

1 4. The detector assembly recited in claim 1 above, wherein said second transducer is  
2 one of a photodiode and further comprises:

3 a semiconducting material, said semiconducting material having a low photon  
4 absorption rate and a low photon scattering rate.

1 5. The detector assembly recited in claim 4 above, wherein said second transducer is  
2 one of a photodiode and an avalanche photodiode (APD).

1 6. The detector assembly recited in claim 4 above, wherein said second transducer is  
2 an avalanche photodiode (APD).

1 7. The detector assembly recited in claim 5 above, wherein said first transducer is a  
2 photomultiplier (PMT).

1 8. The detector assembly recited in claim 1 above further comprises:  
2 a third transducer for receiving one of the plurality of optical signals from said  
3 scintillator crystal and converting the one of the plurality of optical signals to a third  
4 electrical signal, said third transducer having a third active area for receiving optical  
5 signals, and said third active area of said first transducer being optically coupled to the  
6 first end of said scintillator crystal.

1 9. The detector assembly recited in claim 5 above, wherein said first and third  
2 transducers are photomultipliers (PMT) and said second transducer is an avalanche  
3 photodiode (APD).

1 10. The detector assembly recited in claim 9 above, wherein said scintillator crystal  
2 being optically coupled between a plurality of optical guides and a plurality of  
3 photomultipliers (PMT).

1 11. The detector assembly above in claim 1 recited, wherein said first electrical signal  
2 is related to a first distance from the first active area of the first transducer and an  
3 interaction point where said photon interacted with said scintillator crystal.

1 12. The detector assembly recited in claim 11 above, wherein said second electrical  
2 signal is related to a second distance from the second active area of the second transducer  
3 and the interaction point.

1 13. The detector assembly recited in claims 12 above, wherein a depth of interaction  
2 (DOI) for the photon in said scintillator crystal is determined from said first electrical  
3 signal, said second electrical signal and a distance between said first and second ends.

1 14. The detector assembly recited in claim 1 above, wherein said scintillator crystal  
2 further comprises:

3 a bismuth germanate (BGO) crystal.

1 15. The detector assembly recited in claim 1 above, wherein said scintillator crystal  
2 further comprises:

3 a plurality of bismuth germanate (BGO) crystals.

1 16. The detector assembly recited in claim 1 above, wherein said scintillator crystal  
2 further comprises:

3 a sodium iodate (NaI) crystal.

1 17. The detector assembly above in claim 1 recited, wherein said scintillator crystal  
2 further comprises:

3 a plurality of sodium iodate (NaI) crystals.

- 1 18. The detector assembly above in claim 1 recited, wherein a distance between said
- 2 first and second ends exposes an oblique angle to a photon.